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Spectroscopy of highly charged ions with two complementary electron beam ion traps in Tokyo

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An electron beam ion trap (EBIT) [1] is a beneficial device for studying the spectra of highly charged ions. It consists of a Penning-like ion trap and a quasi-mono-energetic unidirectional electron beam traveling through the trap. It can thus provide benchmark spectra with a narrow charge state distribution under a well-defined plasma condition. It is thus helpful for identifying previously unreported lines. At the University of Electro-Communications in Tokyo, we have been using two complementary EBITs, a high-energy device called the Tokyo-EBIT [2] and a compact and low-energy device called CoBIT [3], for studying highly charged ions with a wide range of charge states. This talk presents our recent studies performed with the two EBITs relevant to astrophysical and fusion plasmas.

In the spectroscopic diagnostics of the solar corona, the electron density, which is one of the most important parameters, is generally diagnosed using intensity ratios observed for density-sensitive line pairs. For proper diagnostics, the sensitivity of the line pair intensity ratio to the density should be described by a reliable collisional radiative model evaluated by experimental data obtained under well-defined conditions. Figure 1 shows the intensity ratio of density-sensitive line pairs in Ar XIV, which is useful for the diagnostics of solar corona active regions with a temperature higher than 3 MK [4]. The experimental results obtained using the two EBITs can be used to evaluate a collisional radiative model calculation shown by the solid lines. In this example, good agreement is obtained.

In the ITER fusion plasma, tungsten ions are considered as the most unwanted impurity that causes serious radiation loss. It is thus important to understand the influx and charge evolution of tungsten ions in the plasma through spectroscopic diagnostics. Since the temperature of the ITER plasma spans a wide range from the edge to the core regions, various spectroscopic data of tungsten ions over a wide range of charge states are required for proper diagnostics. We study tungsten spectra using the two EBITs for identifying previously unreported lines for a wide range of charge states [5-6].

For other studies that can not be introduced in this presentation, please see our recent publications [7-8].

References

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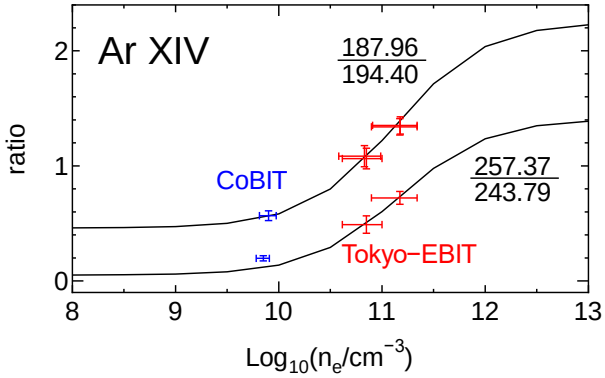

Figure 1. Electron density dependence of density sensitive line intensity ratios in Ar XIV. The numbers represent the wavelength of the lines in Angstrom. The experimental data from the Tokyo-EBIT and CoBIT are plotted in red and blue, respectively. The solid curve represents the result of a CRM calculation.